FIG. 1

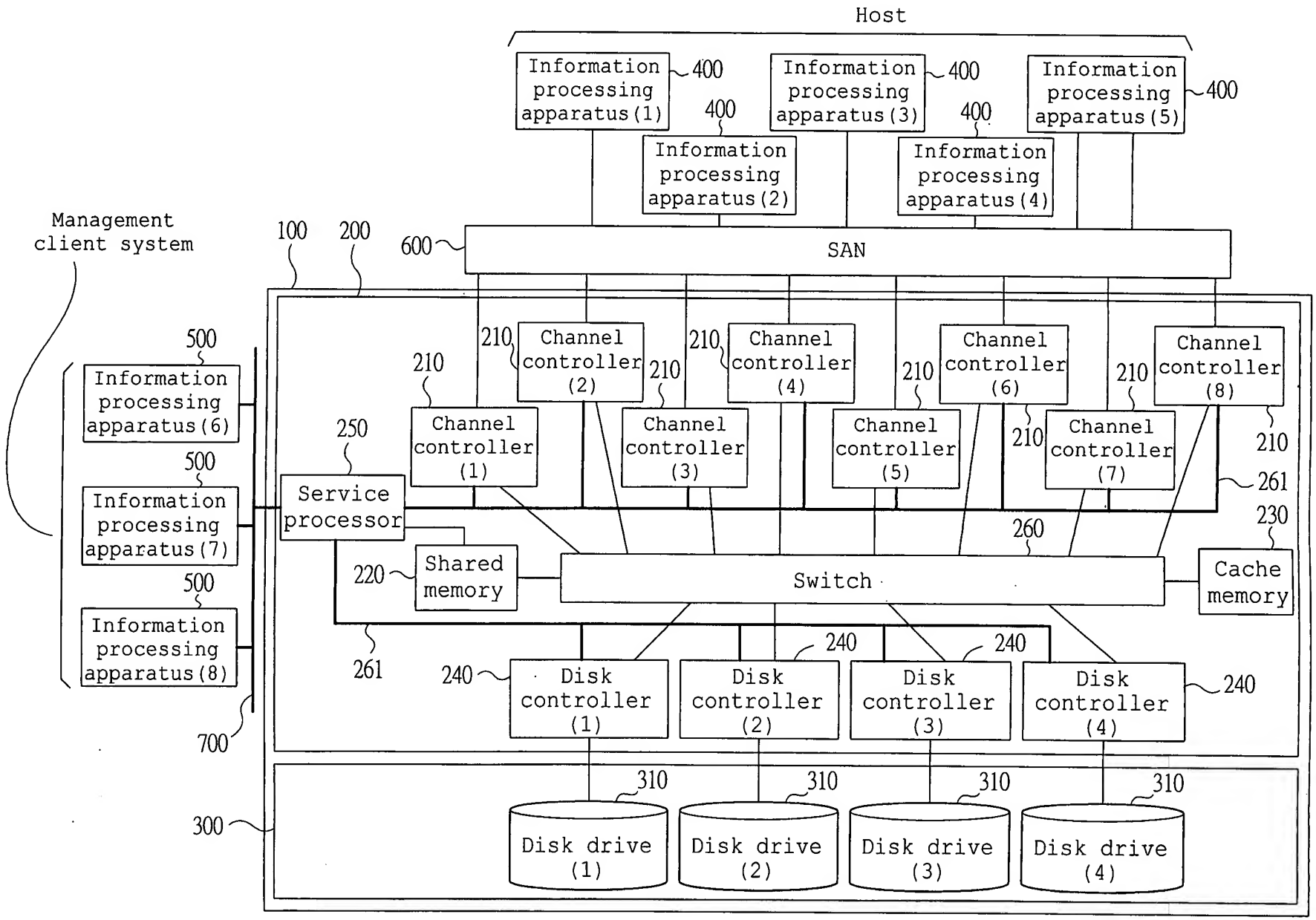
Host
Information processing apparatus (1)
Information processing apparatus (2)
Information processing apparatus (3)
Information processing apparatus (4)
Information processing apparatus (5)
400
Management client system
100
200
600
SAN
500
Information processing apparatus (6)
Information processing apparatus (7)
Information processing apparatus (8)
700
210
Channel controller (1)
Channel controller (2)
Channel controller (3)
Channel controller (4)
Channel controller (5)
Channel controller (6)
Channel controller (7)
Channel controller (8)
250
Service processor
220
Shared memory
260
Switch
230
Cache memory
261
240
Disk controller (1)
Disk controller (2)
Disk controller (3)
Disk controller (4)
300
310
Disk drive (1)
Disk drive (2)
Disk drive (3)
Disk drive (4)

FIG. 2

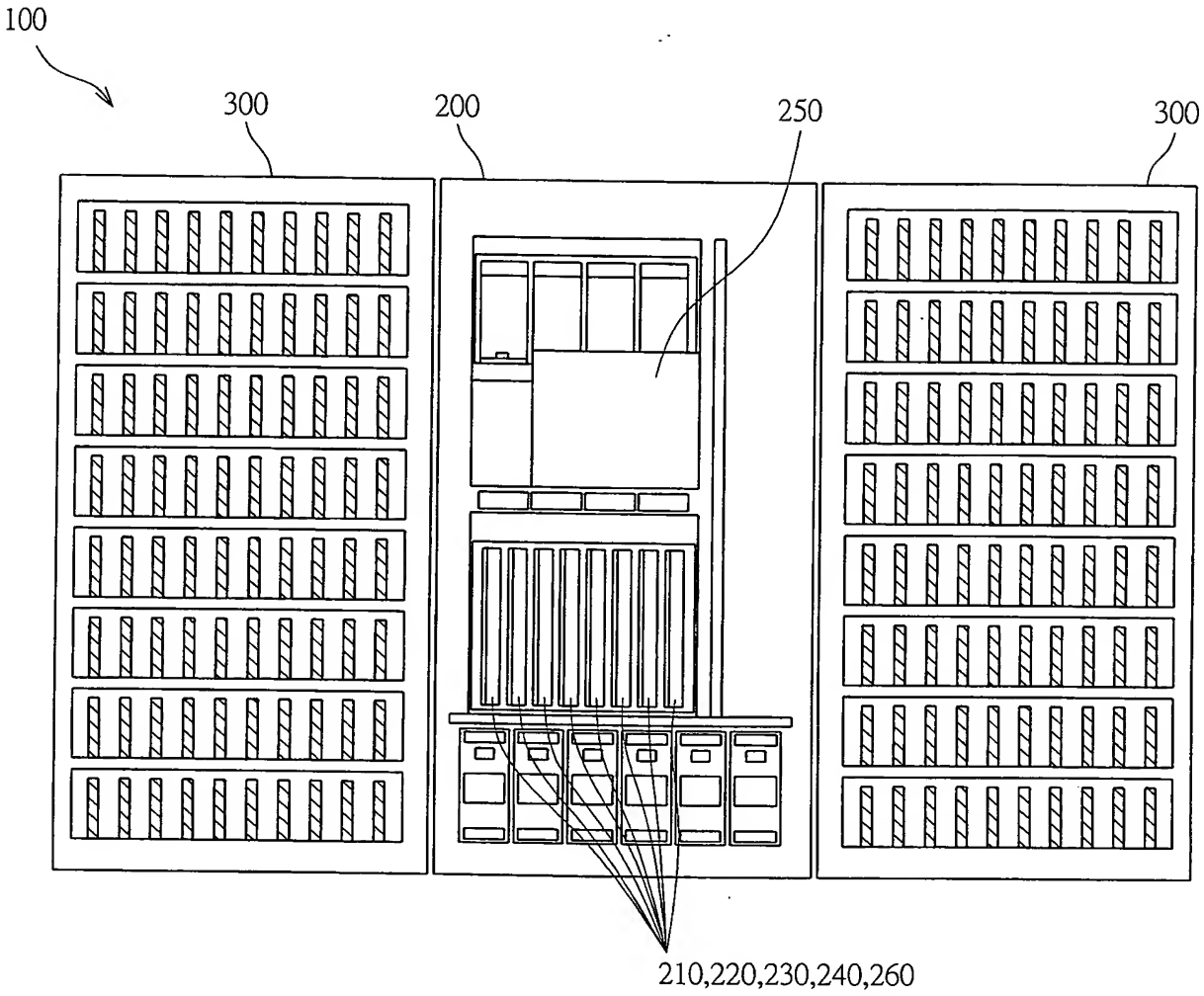

FIG. 3

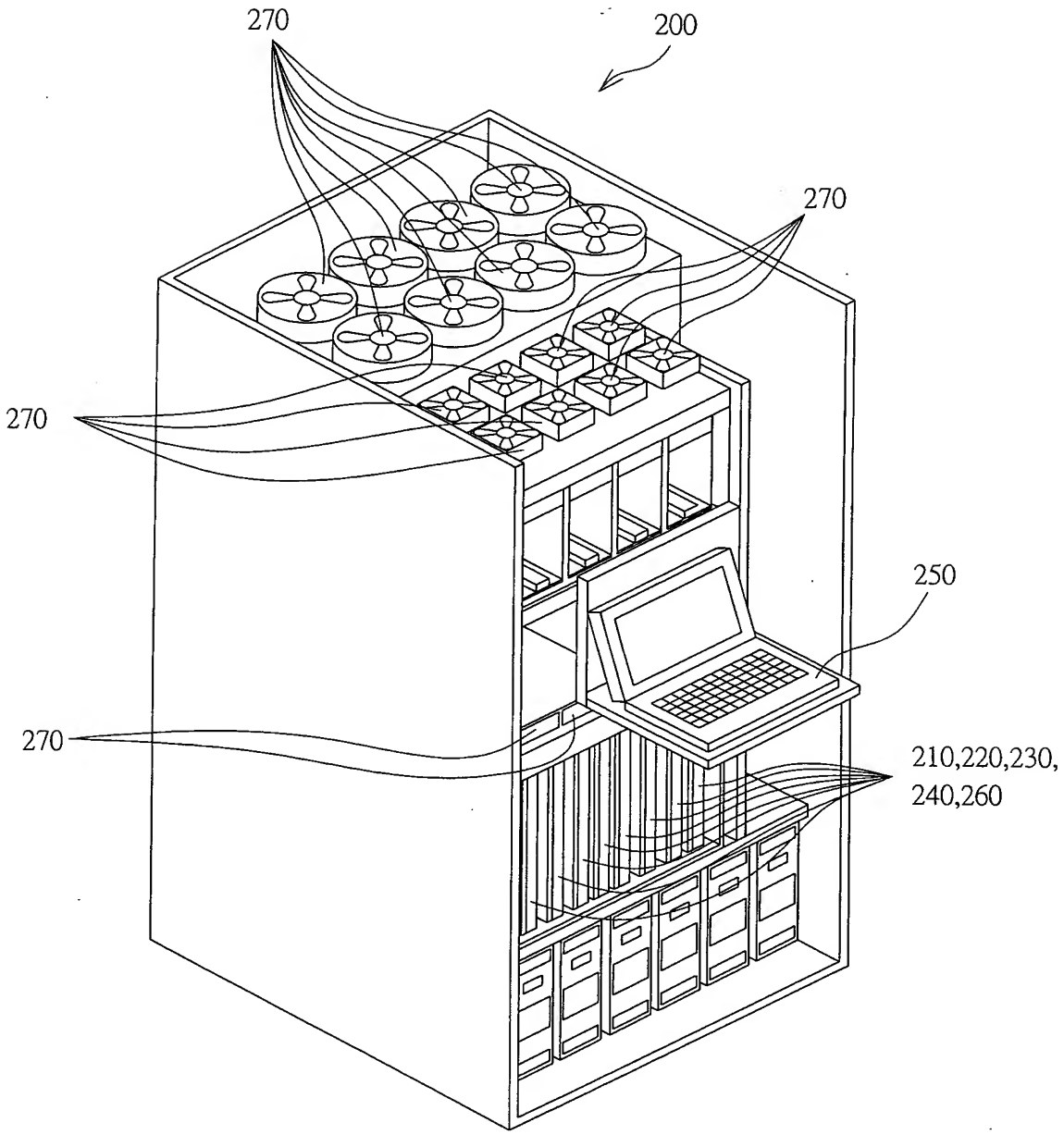

FIG. 4

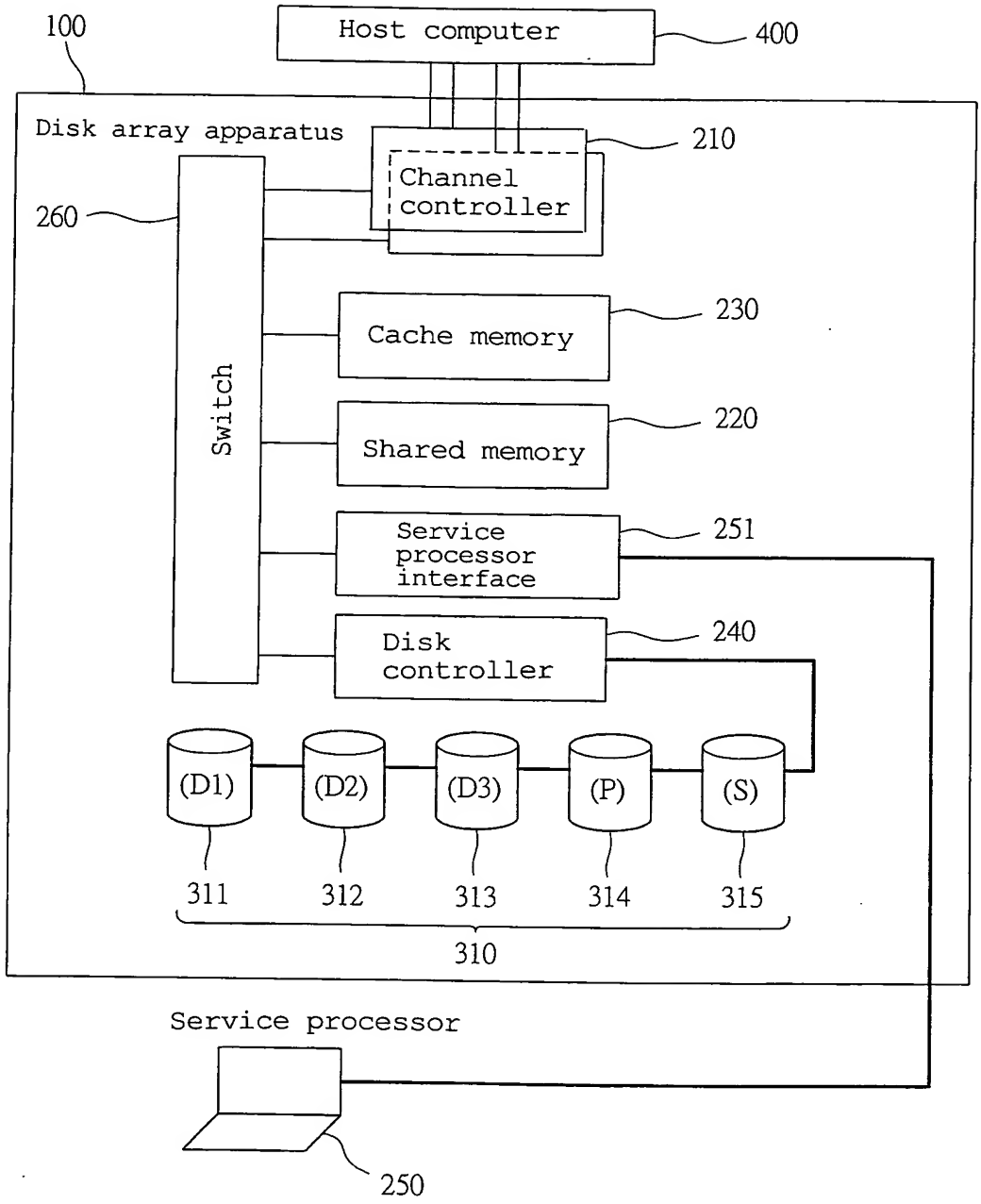
100
Host computer
400
Disk array apparatus
210
Channel controller
260
Switch
Cache memory
230
Shared memory
220
Service processor interface
251
Disk controller
240
(D1)
(D2)
(D3)
(P)
(S)
311
312
313
314
315
310
Service processor
250

FIG. 5

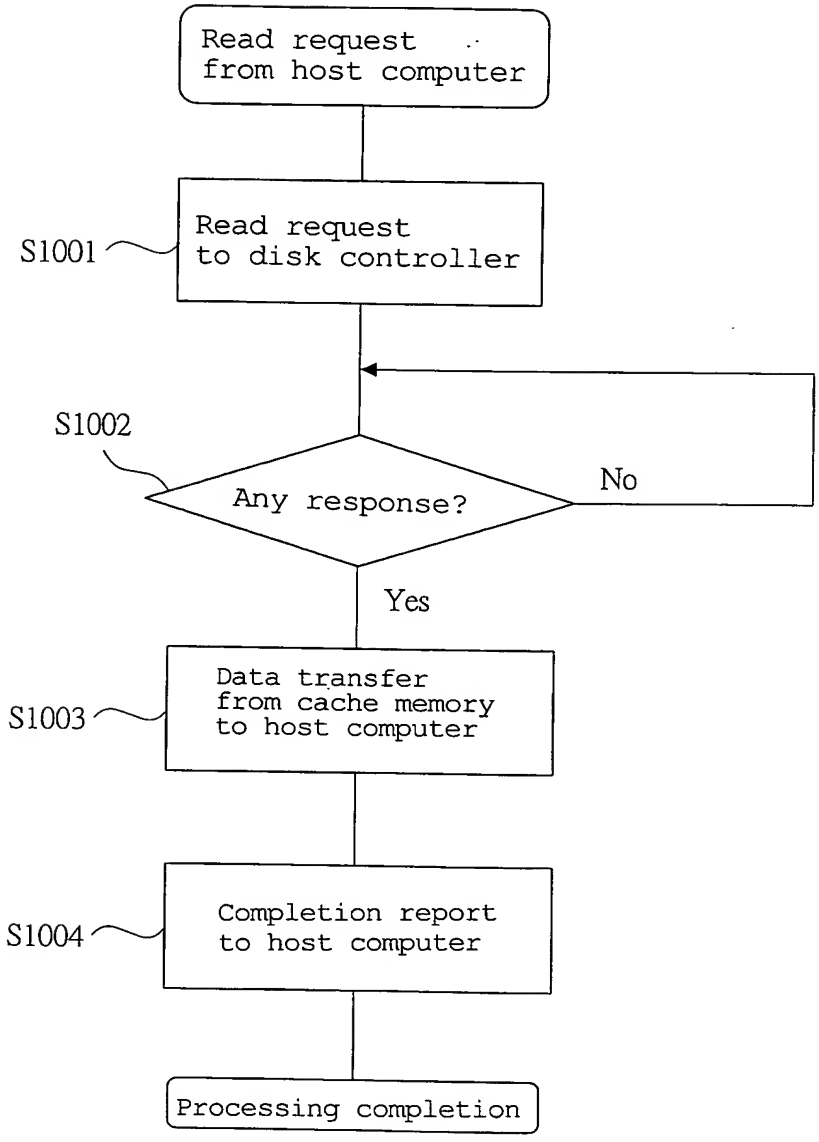
Read request from host computer
S1001
Read request to disk controller
S1002
Any response?
No
Yes
S1003
Data transfer from cache memory to host computer
S1004
Completion report to host computer
Processing completion

FIG. 6

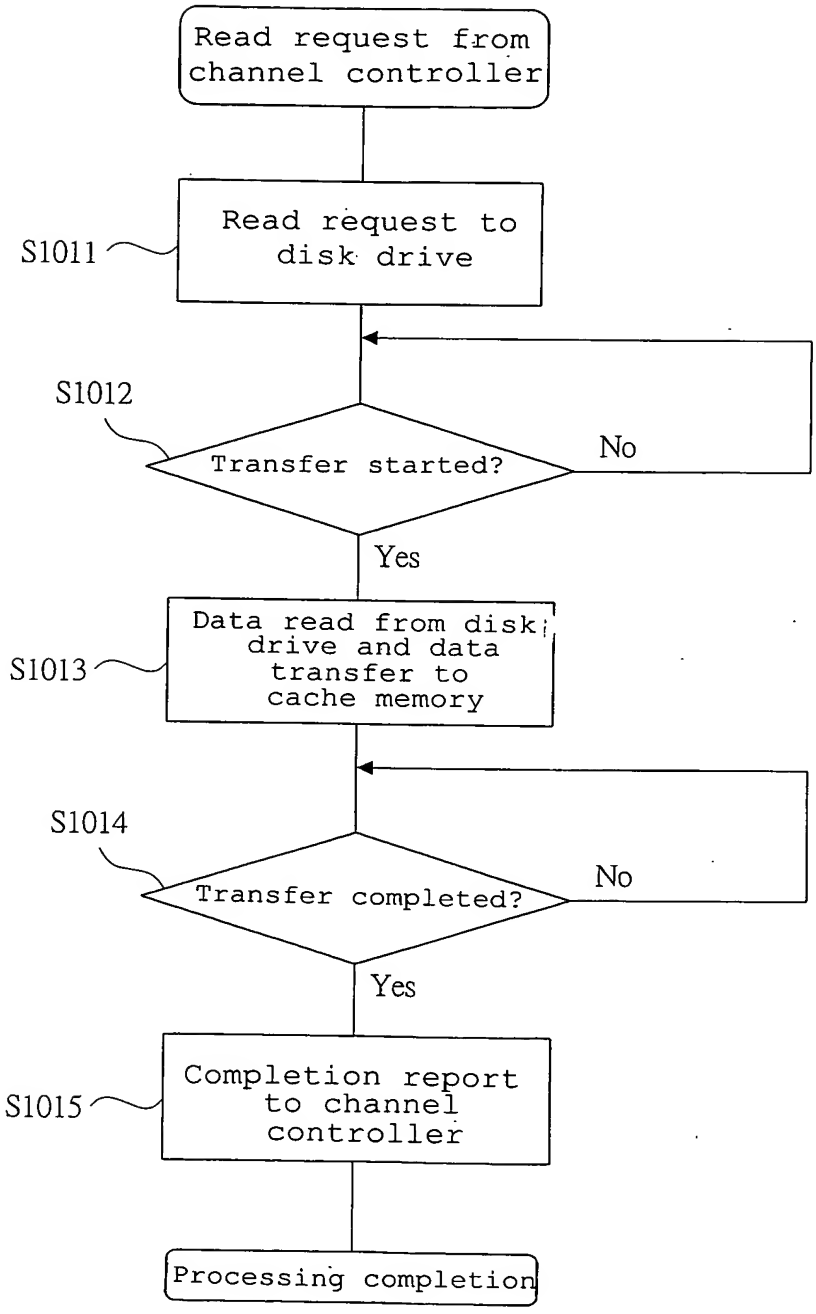
Read request from channel controller
S1011
Read request to disk drive
S1012
Transfer started?
No
Yes
S1013
Data read from disk drive and data transfer to cache memory
S1014
Transfer completed?
No
Yes
S1015
Completion report to channel controller
Processing completion

FIG. 7

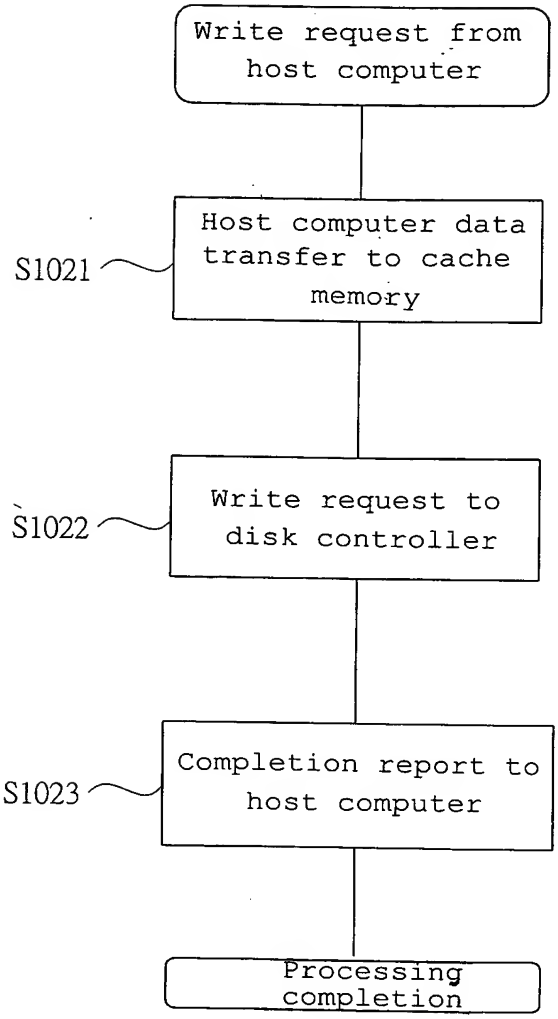
Write request from host computer
S1021
Host computer data transfer to cache memory
S1022
Write request to disk controller
S1023
Completion report to host computer
Processing completion

FIG. 8

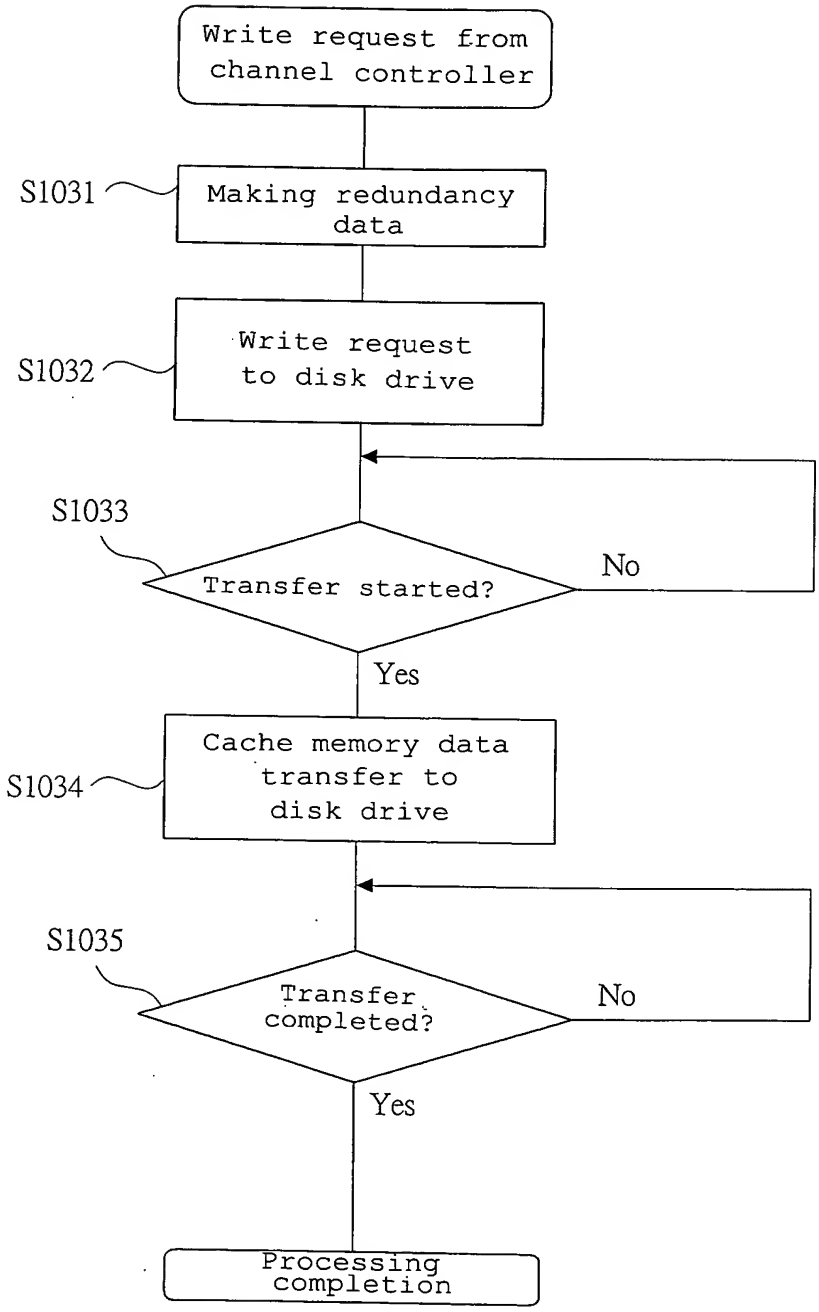
Write request from channel controller
S1031
Making redundancy data
S1032
Write request to disk drive
S1033
Transfer started?
No
Yes
S1034
Cache memory data transfer to disk drive
S1035
Transfer completed?
No
Yes
Processing completion

FIG. 9

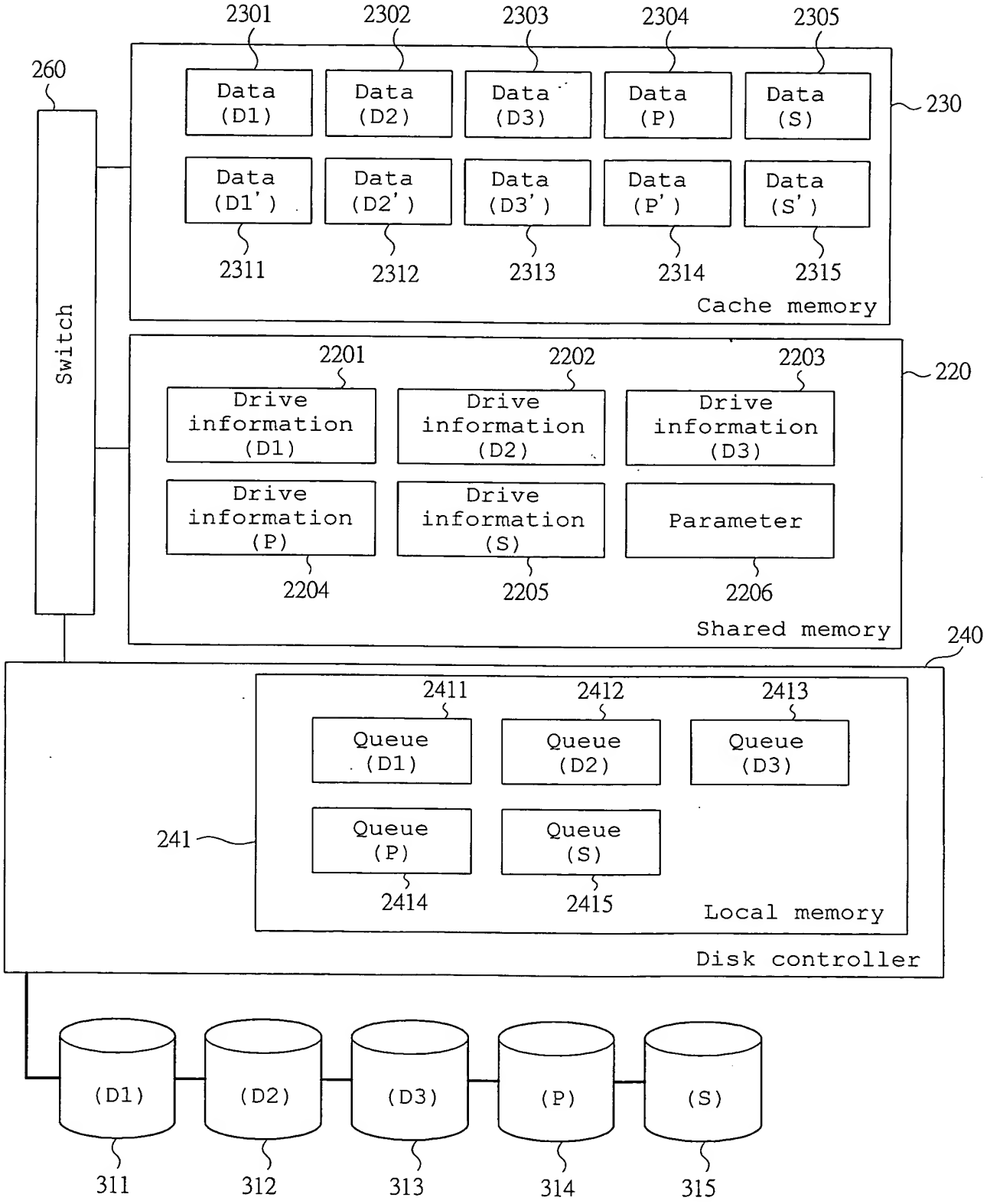
2301
2302
2303
2304
2305
260
Data (D1)
Data (D2)
Data (D3)
Data (P)
Data (S)
230
Data (D1')
Data (D2')
Data (D3')
Data (P')
Data (S')
2311
2312
2313
2314
2315
Cache memory
Switch
2201
2202
2203
220
Drive information (D1)
Drive information (D2)
Drive information (D3)
Drive information (P)
Drive information (S)
Parameter
2204
2205
2206
Shared memory
240
2411
2412
2413
Queue (D1)
Queue (D2)
Queue (D3)
241
Queue (P)
Queue (S)
2414
2415
Local memory
Disk controller
(D1)
(D2)
(D3)
(P)
(S)
311
312
313
314
315

FIG. 10

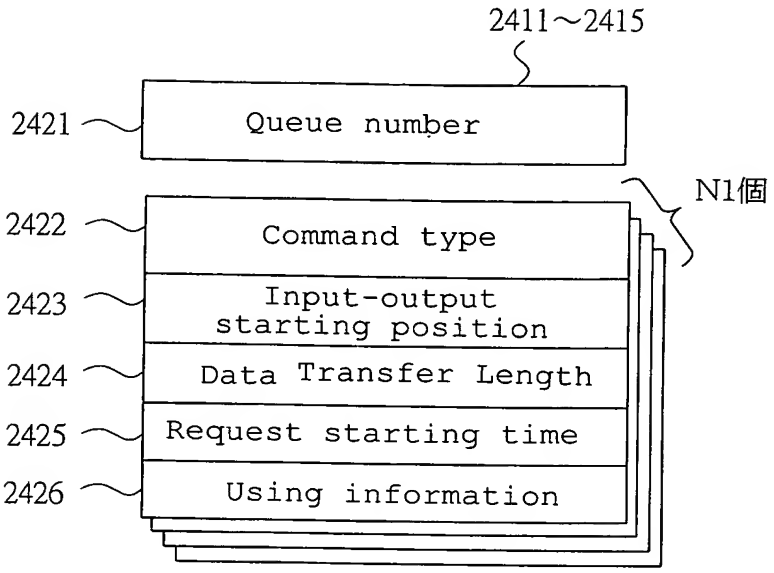
2411～2415
2421
Queue number
N1個
2422
Command type
2423
Input-output starting position
2424
Data Transfer Length
2425
Request starting time
2426
Using information

FIG. 11

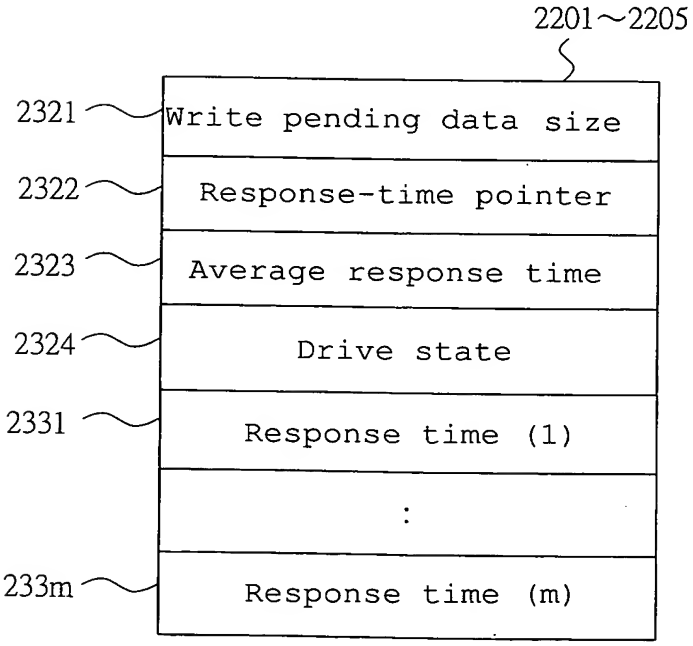
2201～2205
2321
Write pending data size
2322
Response-time pointer
2323
Average response time
2324
Drive state
2331
Response time (1)
:
233m
Response time (m)

FIG.12

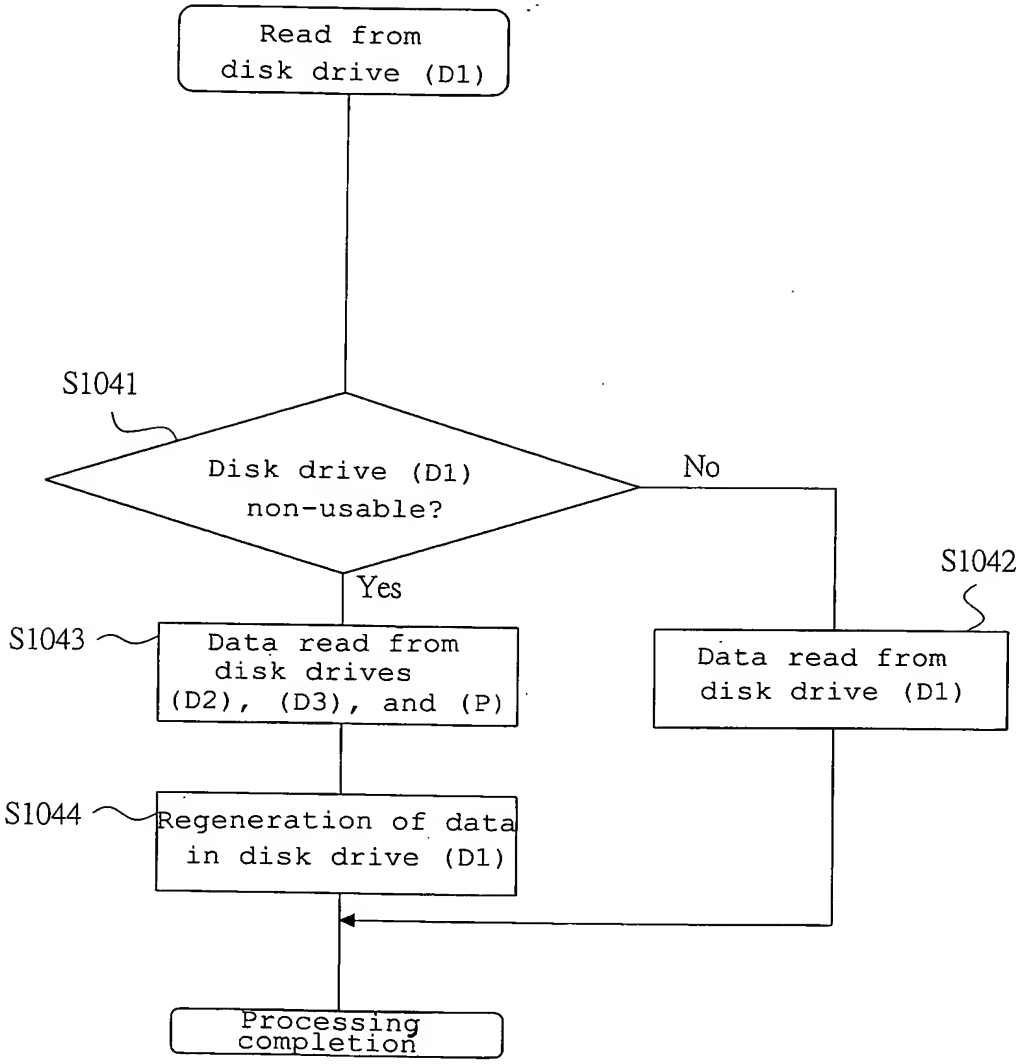
Read from disk drive (D1)
S1041
Disk drive (D1) non-usable?
No
Yes
S1042
S1043
Data read from disk drives (D2), (D3), and (P)
Data read from disk drive (D1)
S1044
Regeneration of data in disk drive (D1)
Processing completion

FIG. 13

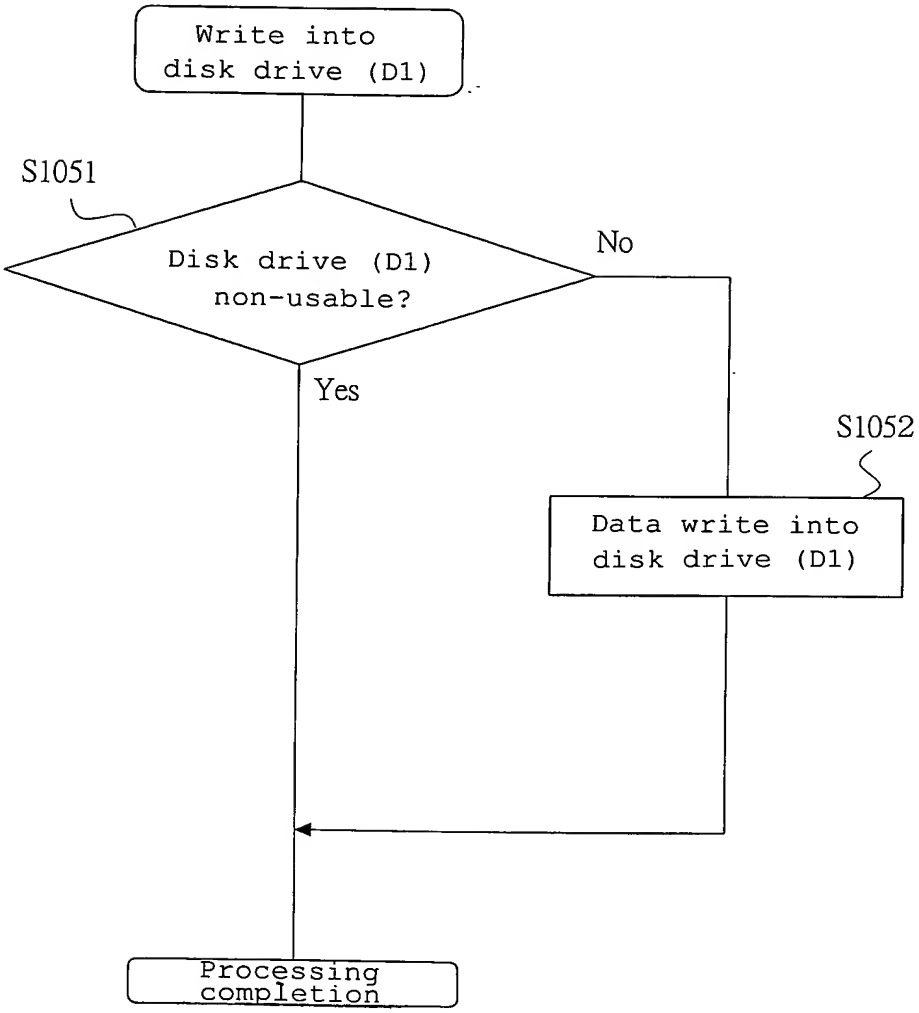
Write into disk drive (D1)
S1051
Disk drive (D1) non-usable?
No
Yes
S1052
Data write into disk drive (D1)
Processing completion

FIG. 14

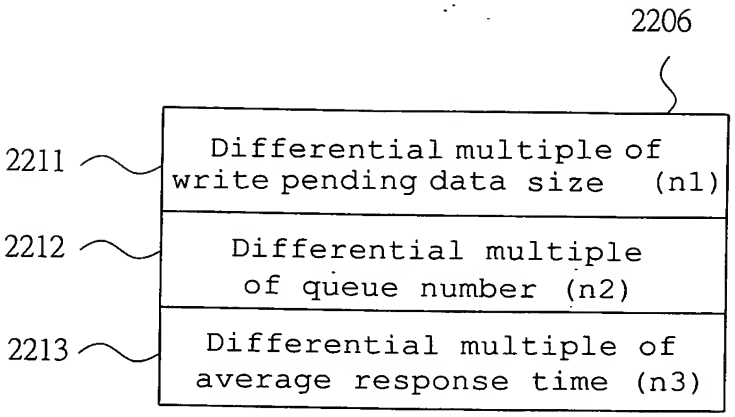
2206
2211
Differential multiple of write pending data size (n1)
2212
Differential multiple of queue number (n2)
2213
Differential multiple of average response time (n3)

FIG. 15

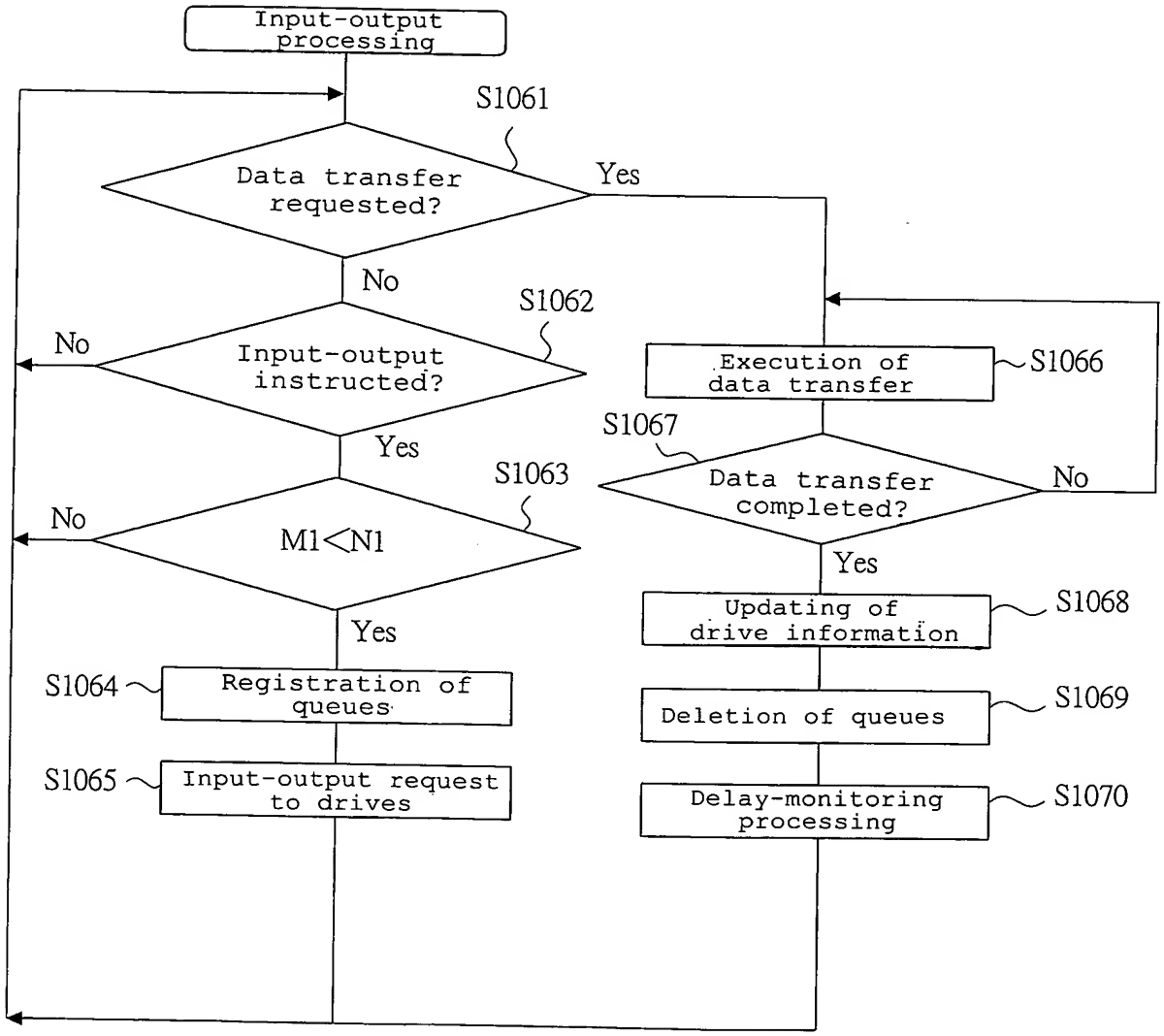
Input-output processing
S1061
Data transfer requested?
Yes
No
S1062
Input-output instructed?
No
Yes
S1063
M1<N1
No
Yes
S1064
Registration of queues
S1065
Input-output request to drives
Execution of data transfer
S1066
S1067
Data transfer completed?
No
Yes
Updating of drive information
S1068
Deletion of queues
S1069
Delay-monitoring processing
S1070

Fig.16A

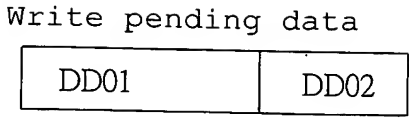

Fig.16B

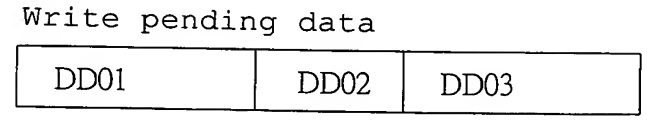

Fig.16C

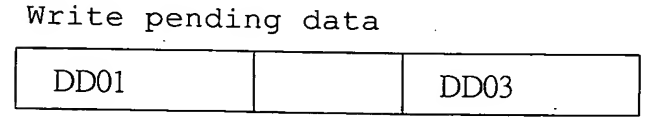

FIG. 17

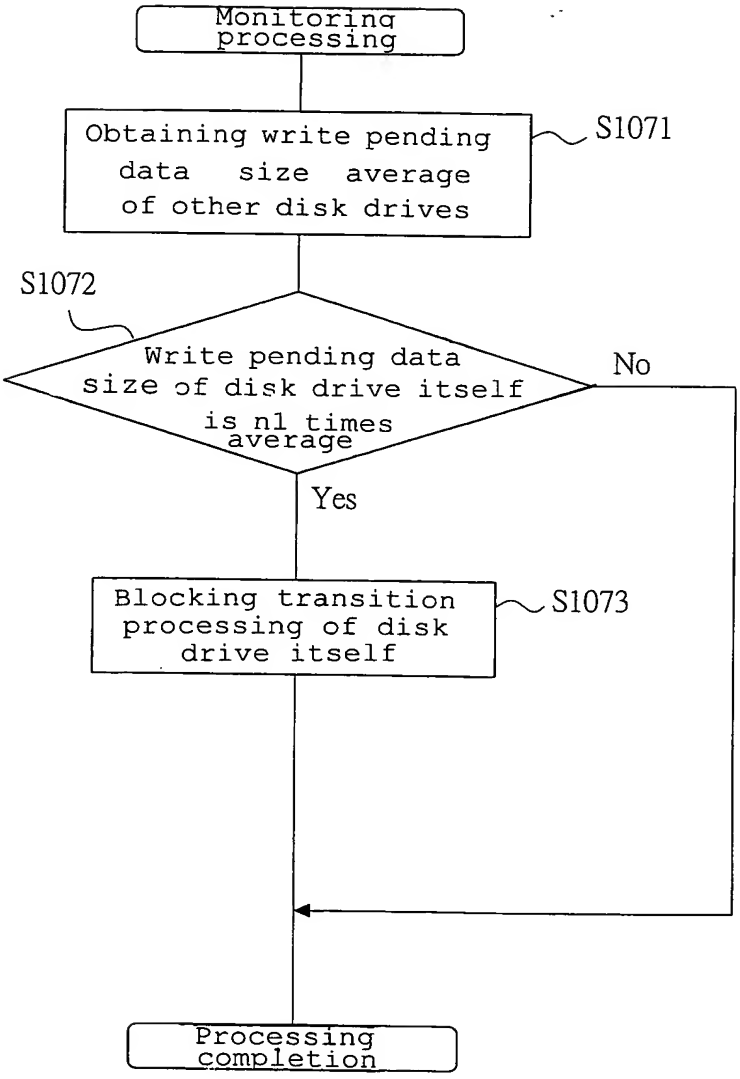
Monitoring processing
Obtaining write pending data size average of other disk drives
S1071
S1072
Write pending data size of disk drive itself is n1 times average
No
Yes
Blocking transition processing of disk drive itself
S1073
Processing completion

FIG. 18

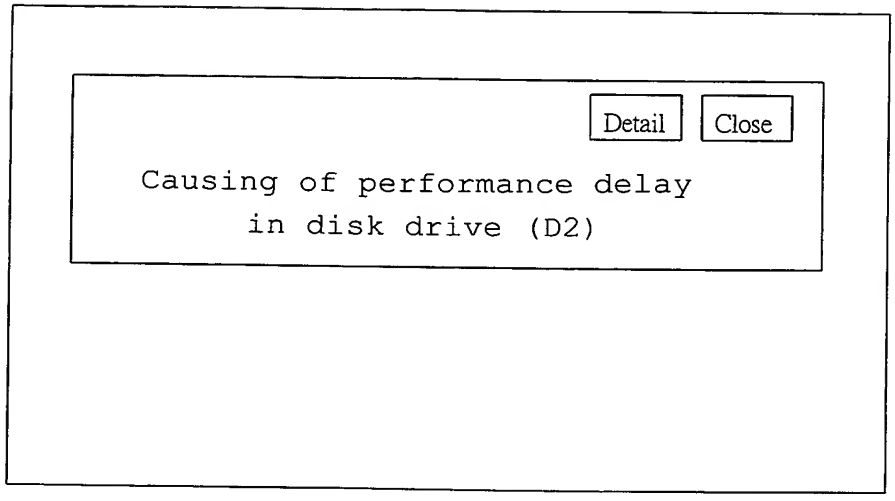

FIG. 19

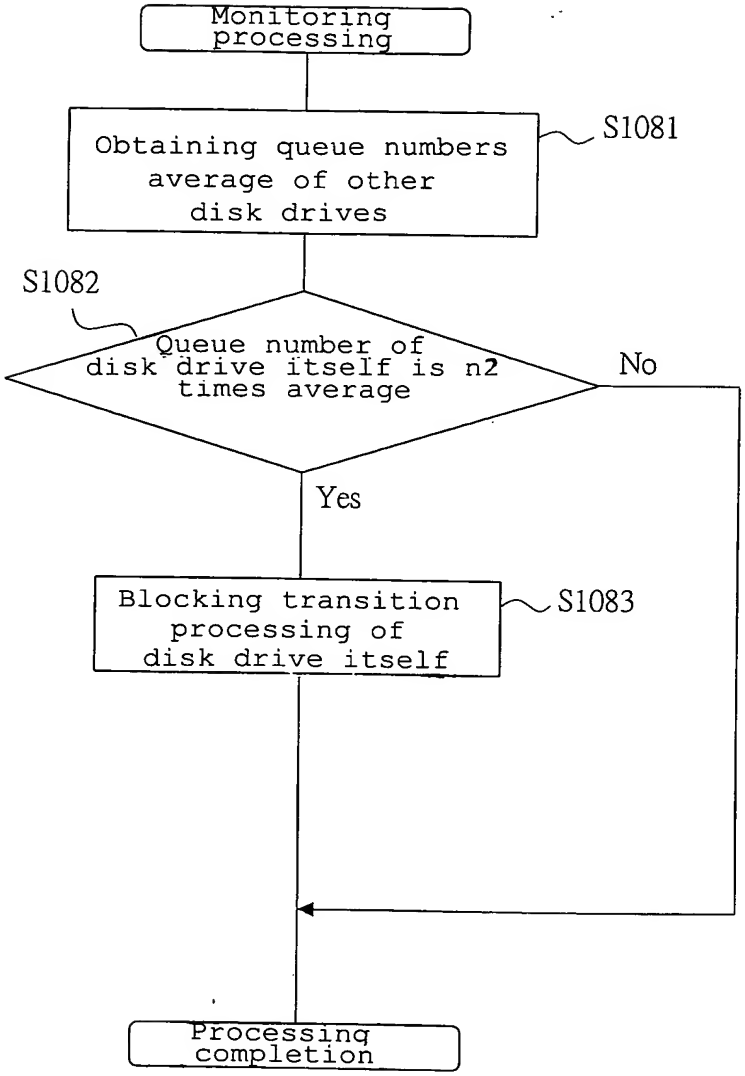
Monitoring processing
Obtaining queue numbers average of other disk drives
S1081
S1082
Queue number of disk drive itself is n2 times average
No
Yes
Blocking transition processing of disk drive itself
S1083
Processing completion

FIG. 20

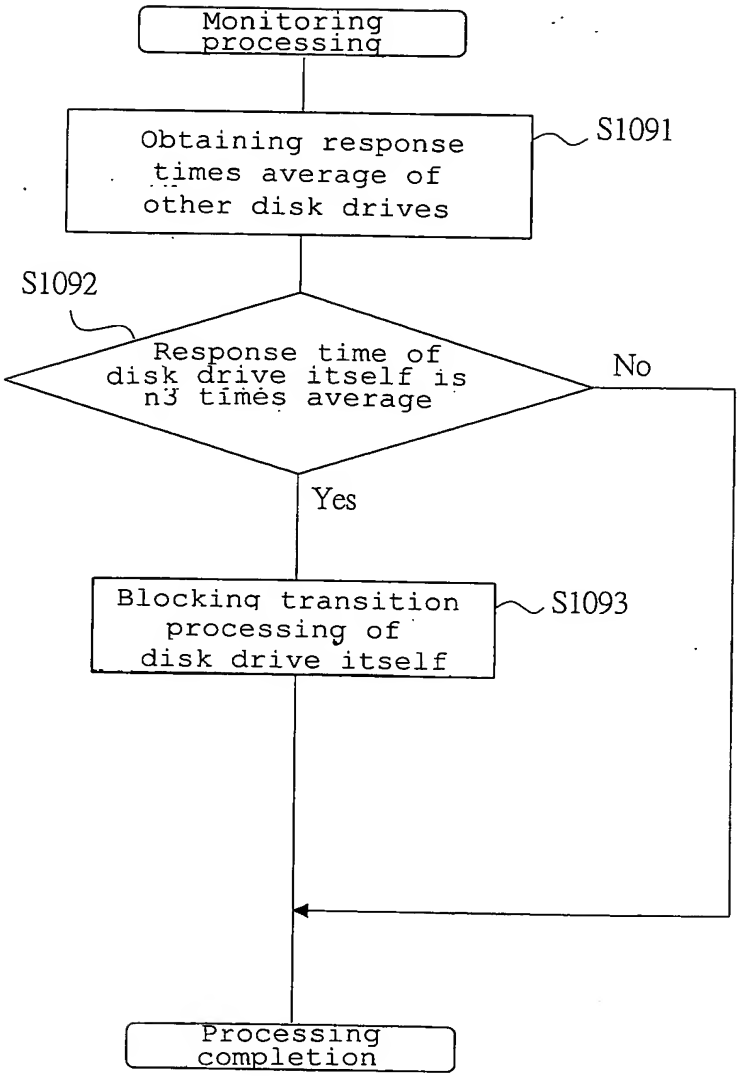
Monitoring processing
Obtaining response times average of other disk drives
S1091
S1092
Response time of disk drive itself is n3 times average
No
Yes
Blocking transition processing of disk drive itself
S1093
Processing completion

FIG. 21

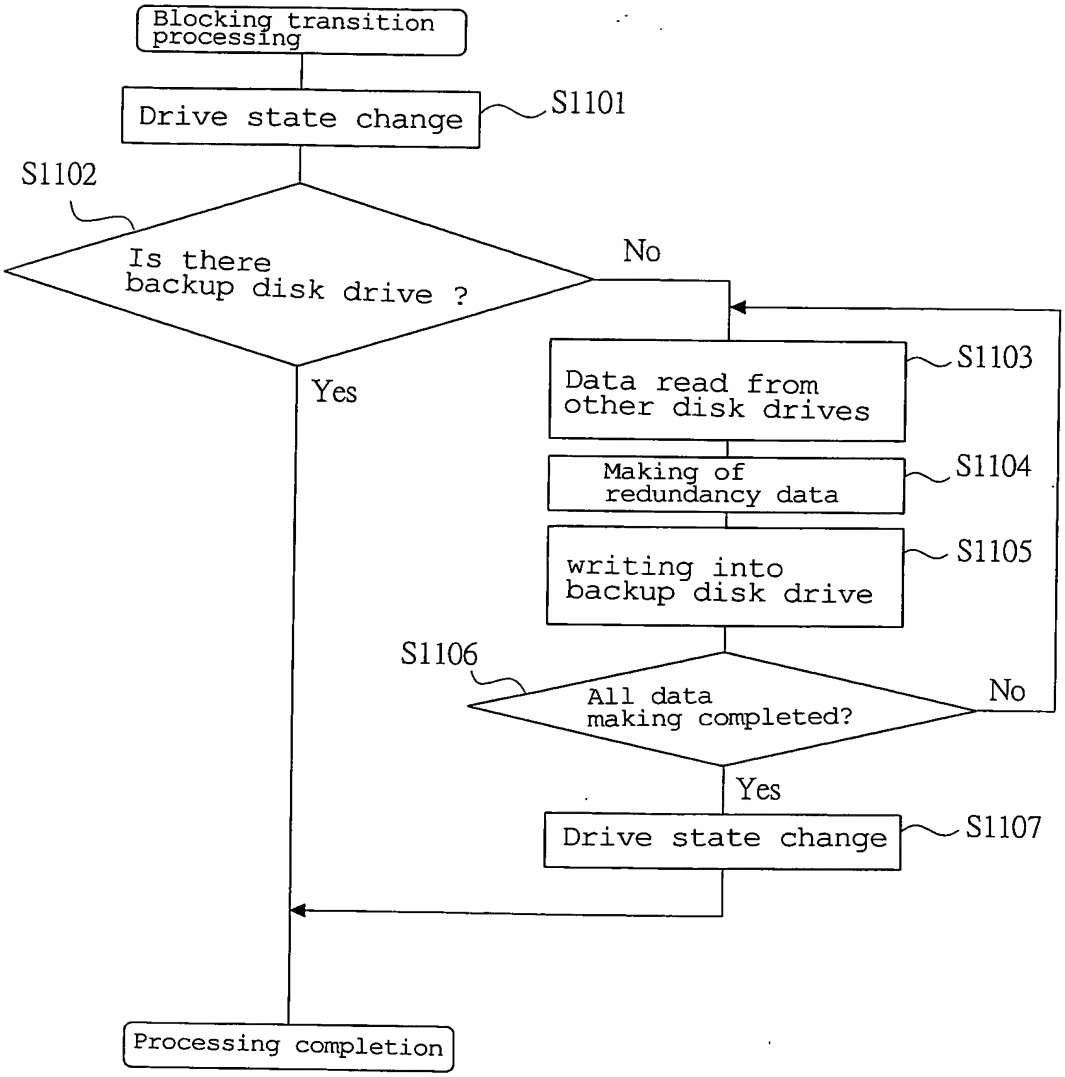
Blocking transition processing
Drive state change
S1101
S1102
Is there backup disk drive ?
No
Yes
Data read from other disk drives
S1103
Making of redundancy data
S1104
writing into backup disk drive
S1105
S1106
All data making completed?
No
Yes
Drive state change
S1107
Processing completion

FIG. 22

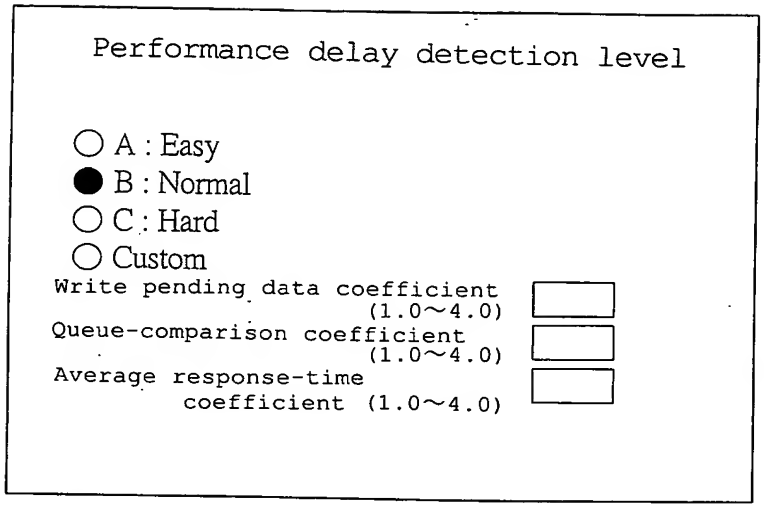

FIG. 23

Level	n1	n2	n3
A	1.2	1.2	1.2
B	1.5	1.5	1.5
C	2.0	2.0	2.0
Custom	Desired value	Desired value	Desired value

FIG. 24

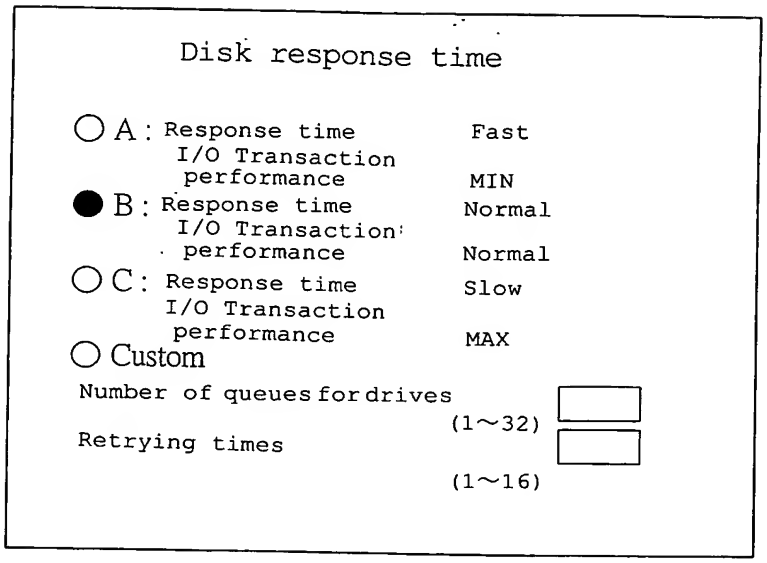

FIG. 25

Level	M1	Retrying times
A	1	5
B	4	10
C	8	20
Custom	Desired value	Desired value